

Dosing Gravity Drainfield Systems

Recommended Standards and Guidance for
Performance, Application, Design, and Operation and Maintenance



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Preface

The recommended standards contained in this document have been developed for statewide application. Regional differences may, however, result in application of this technology in a manner different than it is presented here. In some localities, greater allowances than those described here may reasonably be granted. In other localities, allowances that are provided for in this document may be restricted. In either setting, the local health officer has full authority in the application of this technology, consistent with Chapter 246-272 WAC and local jurisdictional rules. If any provision of these recommended standards is inconsistent with local jurisdictional rules, regulations, ordinances, policies, procedures, or practices, the local standards take precedence. Application of the recommended standards presented here is at the full discretion of the local health officer.

Local jurisdictional application of these recommended standards may be:

- 1) **Adopted as part of local rules, regulations or ordinances**—When the recommended standards, either as they are written or modified to more accurately reflect local conditions, are adopted as part of the local rules, their application is governed by local rule authority.
- 2) **Referred to as technical guidance in the application of the technology**—The recommended standards, either as they are written or modified to more accurately reflect local conditions, may be used locally as technical guidance.

Application of these recommended standards may occur in a manner that combines these two approaches. How these recommended standards are applied at the local jurisdictional level remains at the discretion of the local health officer and the local board of health.

The recommended standards presented here are provided in typical rule language to assist those local jurisdictions where adoption in local rules is the preferred option. Other information and guidance is presented in text boxes with a modified font style to easily distinguish it from the recommended standards.

Acknowledgements—

The Department of Health Wastewater Management Program appreciates the contribution of many persons in the on-going development, review, and up-dating of the Recommended Standards and Guidance documents. The quality of this effort is much improved by the dedication, energy, and input from these persons, including:

- ☐ Geoflow, Inc.
- ☐ Lombardi and Associates
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- ☐ Washington State On-Site Sewage Association (WOSSA)
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- ☐ Waste Water Technologies

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Introduction—

A dosing system provides for the periodic discharge of a determined volume of effluent to a drainfield. Dosing uses the principle of wetting and resting, which provides multiple daily dosings of effluent to a subsurface soil absorption system with a period of resting and re-aeration between doses. This resting period is important in maintaining the aerobic condition of the soil absorption system in and around the distribution trench or bed, and thus slowing the development of a clog of soil interfaces and subsequent failure that naturally occurs over time.

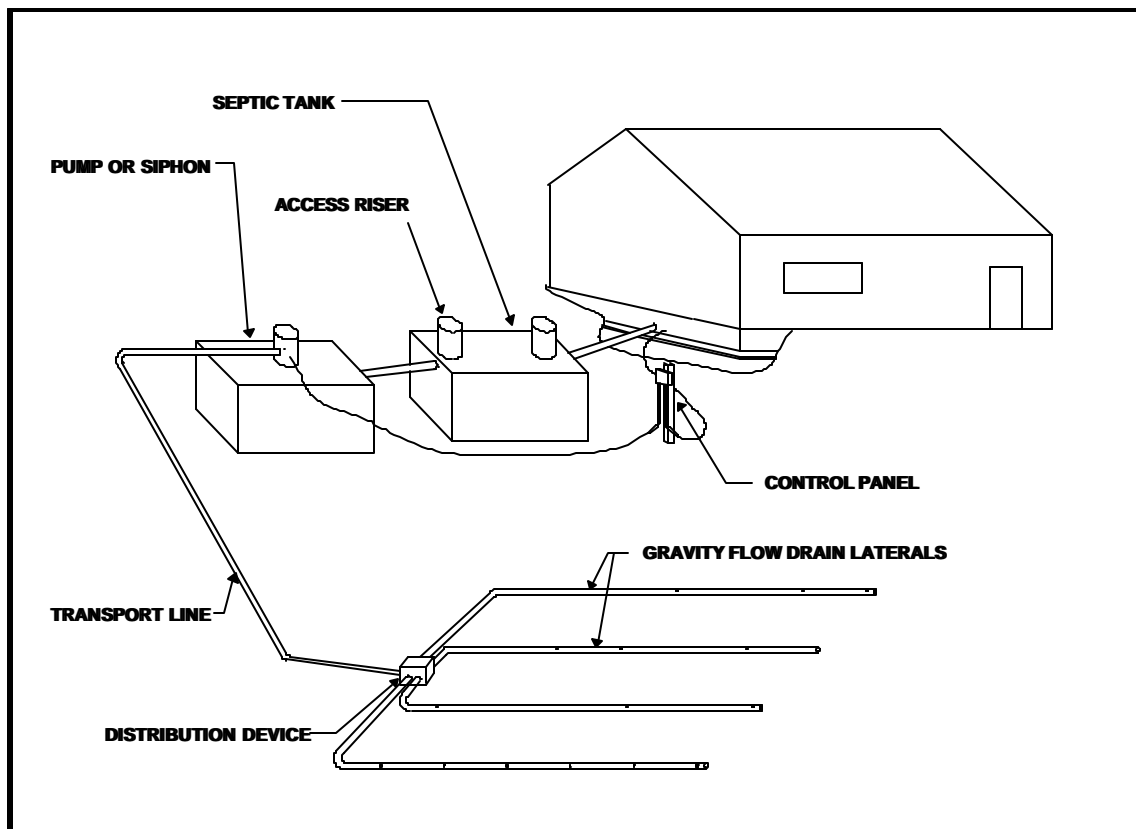
Research evidence indicates that periodic dosing and resting are preferable to continuous effluent discharge into a gravity drainfield. A period of resting allows the soil to re-aerate, limiting the thickness of the clogging mat and allowing aerobic digestion of filtered organic particles in the soil. Because the effluent is discharged in larger doses, the distribution may be more uniform throughout the drainfield than that attained by normal gravity flow.

Dosing systems require the following basic components: septic tank (or other pretreatment to the same quality as domestic septic tank effluent), pump or siphon or equivalent, transport line, distribution device, and laterals, and drainfield. The dose-rest cycle is based either on when the dosing tank fills (demand dosing) or on a time basis (time dosing) at which point the pump or siphon discharges a specific volume to the drainfield. While the transport pipe will be under pressure, unlike pressure distribution systems, the flow in the laterals will not be under pressure.

Figure 1 illustrates the major components of a typical dosing system that are described below.

<u>Component</u>	<u>Primary Function</u>
Septic tank (or other pretreatment device)	Solids separation and storage
Screen	Protect pump or siphon and drainfield from solids
Pump or siphon	Transport a specific volume of effluent from the chamber to the distribution device
Transport line	Pipeline that connects the pump to the distribution device
Distribution device	Distribute the flow from the transport line uniformly to the laterals by gravity or under pressure
Laterals	Gravity sewer drainpipe that distributes effluent within a trench or bed.
Drainfield or other disposal component	Allows the septic tank effluent to pass into native soil or other receiving media where various biological and physical processes provide additional treatment.

Figure 1. Typical Gravity Drainfield System with Dosing



- 1 Performance Standards**— Dosing systems must provide periodic resting and re-aeration to the soil between doses, and apply effluent to the drainfield's infiltrative surface at a rate less than the saturated hydraulic conductivity of the soil. By design, installation, and operation, the system must not contaminate ground or surface waters, expose the public to untreated sewage or be a source of nuisance odors.
- 2 Application Standards**—
 - 2.1 Listing**—A dosing system is a non-proprietary technology and therefore is not listed in the department's List of Approved Systems and Products, but may be permitted by local health officers as there is a DOH Standard and Guidance document available.
 - 2.2 Permitting**—
 - 2.2.1** An installation permit, and if required, an operational permit must be obtained from the appropriate local health officer prior to installation and use.

2.2.2 Dosing is applicable to any on-site sewage system using the soil for disposal and may provide a more satisfactory long-term performance for such systems. Dosing systems are most appropriate where the intermittent application of effluent will assist in either the treatment or disposal of effluent. Soil with slow permeability will benefit the most. Possible applications include:

- 2.2.2.1** For use in a subsurface soil absorption system (drainfield), where a pressure distribution design is not required, and where continuous gravity flow is not feasible or desirable.
- 2.2.2.2** For systems with design flows less than 1000 gallons per day.
- 2.2.2.3** For drainfields with laterals less than one hundred feet in length.
- 2.2.2.4** For sites where vertical separation of 3 feet or greater can be maintained (dosing septic tank effluent).
- 2.2.2.5** For systems in any conventional drainfield design where the soils are of an acceptable permeability and depth, except that systems are not allowed in sites where the soils are of an excessively permeable nature (Type 1A or 2A soils) unless:
 - ➔ a pre-treatment system meeting Treatment Standard 2 is used, or
 - ➔ a method of uniform distribution is used.

Dosing systems are usually used in locations where it is either desirable or required to:

- install the drainfield at a higher elevation than the septic tank;
- treat and dispose of effluent higher in the soil profile; and
- extend the life expectancy of a drainfield or other disposal component

2.2.3 Any application of this technology outside the conditions, allowance or criteria of this standards and guidance document constitutes an experimental system and must be approved by DOH (WAC 246-272-05001).

2.3 Influent Characteristics—

2.3.1 Residential Wastewater: Dosing systems are designed for treating residential strength wastewater. The wastewater applied to drainfields must not be higher in strength than 230 mg/l BOD₅ or 145 mg/l TSS (no TSS particles should be retained on a 1/8-inch mesh screen). Lower wastewater strengths, without increased flow rates are preferable for assuring long term operation of a dosing system.

2.3.2 Non-Residential Wastewater: High-strength wastewater and wastewater from non-domestic sources (such as restaurants, hotels, bed and breakfast establishments, and commercial wastewater sources, etc.) must be individually evaluated for treatability and degree of pretreatment required prior to distribution to the dosing system for final treatment and disposal.

2.4 Pretreatment—

2.4.1 If the wastewater is residential sewage, settleable and floatable solid separation by a properly sized two-compartment septic tank with effluent baffle screening will

suffice. All septic tanks must be designed in compliance with Washington State On-Site Sewage System Regulations (WAC 246-272-11501(2)(d)). Pretreatment with some other approved sedimentation/initial treatment unit may be used instead of a septic tank. Standards and guidance for the design and construction of septic tanks are in the Recommended Standards and Guidance for Pressure Distribution.

- 2.4.2** If the wastewater is from a non-domestic source, influent to the dosing system must be equivalent to residential strength septic tank effluent or lower. Aerobic treatment or some other treatment process may be needed to modify the influent to the dosing system to within the range of residential septic tank effluent quality.

3 Design Standards—

- 3.1 Pump Chamber Requirements—** All pump chambers must be structurally sound and conform to Washington State On-Site Sewage System Regulations (WAC 246-272-11501(2)(e)). The design and construction of pump tanks must comply, where applicable, with the requirements in the Recommended Standards and Guidance for Pressure Distribution.
- 3.2 Pumps, Fittings and Controls—** Pumps must be selected to pump effluent and be capable of meeting the minimum hydraulic flow and head requirements of the proposed on-site system. All pumps, fittings, and controls must meet the minimum applicable requirements found in the Recommended Standards and Guidance for Pressure Distribution.

Dosing can be achieved by either a pump or siphon. Where the soil absorption area is at a higher elevation than the pump, sufficient dynamic head should be provided for both the elevation difference and friction loss. Pumps suitable for pumping sewage effluent must be used. In lieu of pumps, automatic dosing siphons may be used for dosing where a suitable downhill gradient exists from the elevation of the siphon to the drainfield. Careful consideration must be given to manufacturer's specifications during design and installation of automatic siphons.

- 3.3 Minimum Dose Frequency—**The volume of each dose is dependent on the type of soil in which the drainfield will be installed. The minimum dosing frequency must be according to the following table:

<u>Soil Type</u>	<u>Number of Doses/Day</u>
Soil Type 1A and 2A	Conventional gravity systems not allowed (Pressure Distribution Required)
Soil Types 1B, 2B, and 3	4 times per day
Soil Type 4-6	1 to 2 times per day

3.4 Distribution Techniques—

- 3.4.1** Effluent distribution may be accomplished by the use of commercially available pressurized flow splitter devices, distributing valves, or by conventional distribution

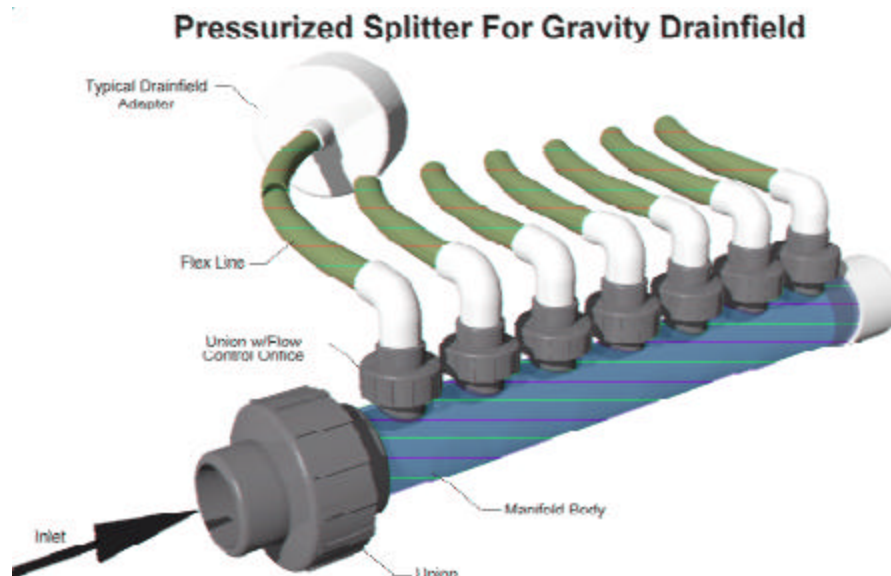
boxes. All distribution devices shall be of sound construction, watertight, not subject to excessive corrosion, and designed for its intended use. They must be placed at a high point so that flow is by gravity in all lines following the device. They must be fitted with risers and watertight lids or covers, extending to grade, which will permit unobstructed access for maintenance, inspection, and operation.

- 3.4.2** Distribution boxes must be installed level to assure that each lateral in the drainfield is receiving an equivalent amount of effluent. Measures must be taken to dissipate the velocity of the influent delivered by a pump or siphon, and to prevent direct flow of effluent across the distribution box resulting in unequal distribution among the outlets.

Although the purpose of the distribution box is to divide effluent flows evenly among drainfield laterals, it is not an efficient or effective method of achieving equal flow splitting. The distribution box should be placed on a concrete pad or otherwise solidly anchored to prevent it from tilting or shifting in place. The use of commercially available outlet pipe leveling devices can compensate in elevation differences in outlets and facilitate leveling adjustments. Because of their constant radius and ease of adjustment, these devices may improve the accuracy with which a box can be leveled initially and in the future.

- 3.4.3** A pressurized flow splitting device such as a pressure manifold may create the most uniform distribution of the distribution devices, regardless of the drainfield lateral length or elevation. Fitting the manifold with orifices sized to permit the percentage of flow desired accommodates different lengths of laterals. An air-release valve (swing-check valve installed in reverse) located at the high point(s) is required if siphoning can occur through the device. Figure 2 shows an example of a pressurized flow splitting device.

Figure 2. Typical Pressurized Flow Splitting Device



3.4.4 Distributing valves can be used as a means for distributing effluent to multiple drainfield laterals or zones. The water pressures in the transport line activate these valves. Each time the pump is turned on, the valve rotates to dose the next drainfield. Figure 3 shows a distributing valve assembly. Distributing valves must be designed with the following features:

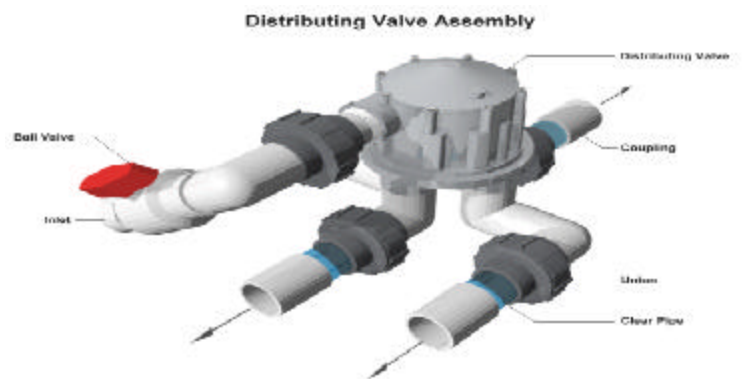
- 3.4.4.1** unions to allow easy removal of the valve
- 3.4.4.2** clear sections of pipe for visual inspection of valve operation
- 3.4.4.3** a ball valve on the inlet for quick testing of valve operation

The best location of the distributing valve for reliable operation is at the high point in the system. The transport line between the pump and valve should be kept full if possible. If the line is empty at the beginning of each cycle, pockets of air during filling can cause random rotation of the valve. To minimize air pockets, the transport line between the pump and valve should be kept full, short, and (most important) laid at a constant grade.

Because of the mechanical movements of these valves, it is necessary to take steps to prevent solids from reaching the valve, which may impede operation. Without adequate septic tank effluent screening, the valve has very little chance of reliable long-term operation. Installation of the valve should not be considered unless a system monitoring program is required for inspecting the valve on a routine frequency. Inspections are necessary to prevent system failure if the valve stops working properly.

Because liquid flow through a distributing valve passes fairly small openings with several changes in direction, head losses through the valve are high. To assure enough head is available for proper system operation, it is recommended that high head turbine pumps be used to pressurize the valve. High pressures through the valve provide a large force for proper seating of the rubber flap disk, thus lowering the leakage that can occur through the openings that are not being pressurized. High head turbine pumps are also recommended because the use of a distributing valve usually requires more frequent pump cycling. The designer should check with the manufacturer to determine the minimum required flow rate through the valve to also assure proper seating of the rubber flap disk.

Figure 3. Typical Distributing Valve



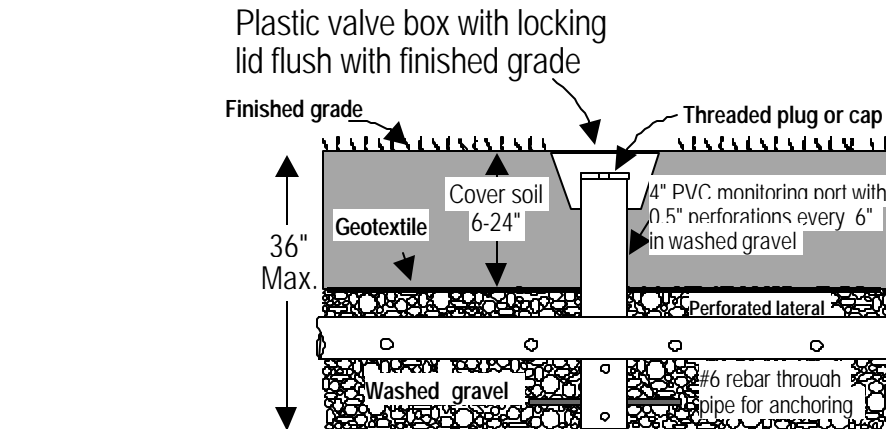
3.5 Trenches/Beds —

- 3.5.1 a dosing drainfield, as in any drainfield, the bottom of the trench/bed must be level, ± 0.5 inches.
- 3.5.2 The bottom and sides of the trench/bed must not be smeared.
- 3.5.3 In gravel-filled trenches and beds, an acceptable geotextile must be used on top of the gravel before backfilling. (See Appendix A).
- 3.5.4 On sloping sites, the trenches and laterals must run parallel to the natural ground contours.
- 3.5.5 The ends of the laterals must be capped.

3.6 Monitoring Ports—All dosing systems must be equipped with a monitoring port in a representative location on each drainfield line. Some drainfield lines may require additional monitoring ports to achieve observations representative of the entire drainfield line. (See Figure 4). These ports must:

- 3.6.1 be accessible from the ground surface,
- 3.6.2 be open and slotted at the bottom, and
- 3.6.3 be void of gravel to the infiltrative surface to allow visual monitoring of standing liquid in the trench or bed.

Figure 4. Typical Monitoring Port Detail



3.7 Minimum Design Submittal—

3.7.1 A complete design must include the following as a minimum:

- 3.7.1.1** all requirements of WAC 246-272-09001(1)
- 3.7.1.2** daily design flow
- 3.7.1.3** septic tank size, location, and outlet invert elevation
- 3.7.1.4** pump pickup elevation and location, or siphon invert elevation and location
- 3.7.1.5** size of pump or siphon chamber
- 3.7.1.6** transport line length, location, highest elevation, and diameter
- 3.7.1.7** all valves, distribution devices, or other such components in the system
- 3.7.1.8** lateral location, length, and elevations
- 3.7.1.9** dose volume, pumping rate (GPM), dose frequency, and total system design head
- 3.7.1.10** location and detail of monitoring ports in the trenches or beds
- 3.7.1.11** detail of pump controls, floats and the position of floats
- 3.7.1.12** an electrical wiring diagram specific to the project
- 3.7.1.13** system parameters and calculations used by the designer to arrive at the component sizing and flow distribution shown in the design
- 3.7.1.14** a user manual for the dosing system must be developed and provided to the homeowner and the local health jurisdiction. See section 3.11 for a list of items to be included in the manual.

3.8 As-Built Information—

3.8.1 A completed as-built submission must contain, at a minimum the following items:

- 3.8.1.1** all the items contained in the design submittal listed above, as installed, identifying any changes from the approved plan
- 3.8.1.2** the measured drawdown per dose cycle
- 3.8.1.3** timer functions, if a timer is installed
- 3.8.1.4** pump run time and pump time off.

4. Operation and Maintenance Standards —

4.1 Dosing systems must be monitored and maintained at a frequency commensurate with the site, soil, system complexity and use patterns. As a minimum, the items in 4.2 - 4.7 must be inspected at six months and then yearly, after the system is put into use. The local health department must require that the permit clearly delineate who must perform the inspections. Refer to the system as-built for initial readings and settings. The owners of dosing systems must be notified that their system must be inspected and serviced on a yearly basis. All findings and repairs are to be recorded, records filed for ready access and reports sent to local health department.

4.2 User's Manual—The user's manual that is a part of the design submittal must contain, at a minimum, the following:

- 3.2.1** diagrams of the system components
- 3.2.2** explanation of system function, operation expectations, owner responsibility, etc.
- 3.2.3** specifications of all electrical and mechanical components installed (occasionally components other than those specified on the plans is used).
- 3.2.4** names and telephone numbers of the system designer, local health authority, component manufacturer, supplier/installer, and/or the management entity to be contacted in the event of a failure
- 3.2.5** information on the periodic maintenance requirements of the various components of the sewage system
- 3.2.6** information on "trouble-shooting" common operational problems that might occur. This information should be as detailed and complete as needed to assist the system owner to make accurate decisions about when and how to attempt corrections of operational problems, and when to call for professional assistance.

4.3 Evaluate septic tank and pump chamber for:

- 4.3.1** Sludge and scum accumulations; pump as necessary.
- 4.3.2** Clogging, damage, and proper placement of outlet baffle screen. Clean the screen each time it is inspected or as needed to avoid clogging.
- 4.3.3** Signs of leaking in tanks and risers. Repair or replace if necessary.
- 4.3.4** Risers and lids being at or above grade and having lids that are secure from unauthorized entry.
- 4.3.5** Properly functioning of floats. Movement should not be restricted. Floats should be positioned correctly and provide positive instrumentation signals. Adjust and repair as necessary.
- 4.3.6** Measure pump run time per cycle and drawdown. Compare with time recorded in as-built.
- 4.3.7** Test alarms for proper functioning (high and low liquid level).

4.4 Evaluate drainfield area for:

- 4.4.1** Indication of surfacing effluent.
- 4.4.2** Appropriate vegetation.
- 4.4.3** Absence of heavy traffic
- 4.4.4** Inappropriate building.
- 4.4.5** Impervious materials or surfaces.

- 4.4.6 Abnormal settling or erosion.
- 4.4.7 Evaluate monitoring ports for evidence of ponding. Check depth of ponding.

4.5 Distribution Devices—

4.5.1 Evaluate D-Box for:

- 4.5.1.1 Uneven settling of D-box
- 4.5.1.2 Levelness of inverts of outlets of D-box
- 4.5.1.3 Uniformity of outlet flow of D-Box
- 4.5.1.4 Depth of effluent in the D-box
- 4.5.1.5 Solids accumulations in the D-box

4.5.2 Evaluate distributing valve for:

- 4.5.2.1 Proper rotation of the valve through the clear sections of outlet pipe

APPENDIX A

Standard Specification for Geotextile in Subsurface Soil Absorption Systems (SSAS)

The geotextile shall be of nonwoven, and meet or exceed the following "Minimum Average Roll Values." The fabric shall be free of any chemical treatment or coating which reduces permeability and shall be inert to chemicals commonly found in soil.

PROPERTY	TEST PROCEDURE VALUE	UNIT	MINIMUM
Grab Strength	ASTM D4632	Lbs.	60
Puncture Tear	ASTM D4833	Lbs.	18
Trapezoid Tear	ASTM D4533	Lbs.	25
Apparent Opening Size (AOS)	ASTM D4751	U.S. Std. Sieve	(1)
Flow Rate	ASTM D4491	gal/ft ² /min	100

(1) Soil with 50% or less particles by weight passing US No. 200 sieve, AOS less than 0.6 mm (greater than #30 US Std. Sieve). Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297 mm (greater than #50 US Std. Sieve).

APPENDIX B

Definitions —

Alternative System: An on-site sewage system other than a conventional gravity system or conventional pressure distribution system. Properly operated and maintained alternative systems provide equivalent or enhanced treatment performance as compared to conventional gravity systems.

Conventional Gravity System: An on-site sewage system consisting of a septic tank and a subsurface soil absorption system with gravity distribution of the effluent.

Disposal Component: A subsurface absorption system (SSAS) or other soil absorption system receiving septic tank or other pretreatment device and transmitting it into original, undisturbed soil.

Distributing valve: A valve that distributes flow to multiple drainfield laterals, zones or locations by automatically rotating upon each pump cycle.

Dosing: The application of wastewater to a treatment or disposal system in discreet amounts over a definite time period, as opposed to an unregulated flow.

Dosing Tank: A tank which collects treated wastewater for period of time and then, periodically, discharges it into another treatment unit or disposal unit, depending upon the needs and design of the particular on-site sewage system.

Drainfield (conventional): An area in which perforated piping is laid in drain rock-packed trenches, or excavations (seepage beds) for the purpose of distributing the effluent from a wastewater treatment unit.

Effluent: Wastewater discharged from a septic tank or other on-site sewage system component.

Failure: A condition of an on-site sewage system that threatens the public health by inadequately treating sewage or creating a potential for direct or indirect contact between sewage and the public. Examples of failure include:

- (a) Sewage on the surface of the ground;
- (b) Sewage backing up into a structure caused by slow absorption of septic tank effluent;
- (c) Sewage leaking from a septic tank, pump chamber, holding tank, or collection system;
- (d) Cesspool or seepage pits where evidence of ground water or surface water quality degradation exists;
- (e) Inadequately treated effluent contaminating ground water or surface water.
- (f) Noncompliance with standards stipulated on the permit.

Final Treatment/Disposal Unit: That portion of an on-site sewage system designed to provide final treatment and disposal of the effluent from a wastewater treatment unit, including, but not limited to, absorption fields (drainfields), sand mounds and sand-lined trenches.

Infiltrative Surface: In drainfields, the drain rock-original soil interface at the bottom of the trench; in mound systems, the gravel-mound sand and the sand-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-sand interface and the sand-original soil interface at the bottom of the trench or bed.

Influent: Wastewater, partially or completely treated, or in its natural state (raw wastewater), flowing into a reservoir, tank, treatment unit, or disposal unit.

On-site Sewage System (OSS): An integrated arrangement of components for a residence, building, industrial establishment or other places not connected to a public sewer system which:

(a) Convey, store, treat, and/or provide subsurface soil treatment and disposal on the property where it originates, upon adjacent or nearby property; and (b) Includes piping, treatment devices, other accessories, and soil underlying the disposal component of the initial and reserve areas.

Pump Chamber: A tank or compartment following the septic tank or other pretreatment process, which contains a pump, floats, and volume for storage for effluent. If a siphon is used, in lieu of a pump, this is called a “siphon chamber”.

Residential Sewage: Sewage having the consistency and strength typical of wastewater from domestic households.

Septic Tank: A watertight pretreatment receptacle receiving the discharge of sewage from a building sewer or sewers, designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic digestion of the organic matter, prior to discharge of the liquid.

Sewage: Any urine, feces, and the water carrying human wastes, including kitchen, bath, and laundry wastes from residences, building, industrial establishments or other places. For the purposes of these guidelines, “sewage” is generally synonymous with domestic wastewater. Also see “residential sewage.”

Soil Type 1A: Very gravelly coarse sands or coarser, extremely gravelly soils.

Subsurface Soil Absorption System - “SSAS”: A system of trenches three feet or less in width, or beds between three feet and ten feet in width, containing distribution pipe within a layer of clean gravel designed and installed in original, undisturbed soil for the purpose of receiving effluent and transmitting it into the soil.

Suitable Soil: Original, undisturbed soil of types 1B through 6.

Treatment Component: A type of on-site sewage system component that modify and/or treat sewage or effluent prior to the effluent being transmitted to another treatment component or a disposal component. Treatment occurs by a variety of physical, chemical, and/or biological means. Constituents of sewage or effluent may be removed or reduced in concentrations.

Vertical Separation: The depth of unsaturated, original, undisturbed soil of Soil Types 1B - 6 between the bottom of a disposal component and the highest seasonal water table, a restrictive layer, or Soil Type 1A.

Wastewater: Water-carried human excreta and/or domestic waste from residences, buildings, industrial establishments or other facilities. (See SEWAGE.)

Wastewater Treatment Unit: A unit designed, constructed, and installed to stabilize liquid waste by biochemical and physical action.

Wastewater Design Flow: The volume of wastewater predicted to be generated by occupants of a structure. For residential dwellings, this volume is calculated by multiplying the number of bedrooms by either 120 or 150 GPD (gallons per day).